

GYPSUM



Indian Minerals Yearbook 2012

(Part- III : Mineral Reviews)

51st Edition

GYPSUM

(FINAL RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

Indira Bhavan, Civil Lines,
NAGPUR – 440 001

PHONE/FAX NO. (0712) 2565471
PBX : (0712) 2562649, 2560544, 2560648
E-MAIL : cme@ibm.gov.in
Website: www.ibm.gov.in

February, 2014

26 Gypsum

Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) is a hydrated calcium sulphate used widely in industry because of its special property of losing three-fourth of the combined water of crystallisation when moderately heated (calcined) to about 130°C . Besides, calcined gypsum when cooled, finely ground and made plastic with water can be spread out, cast or moulded to any desired surface or form. On drying, it sets into a hard rock-like form. Selenite is a colourless, transparent, crystalline variety of gypsum, whereas alabaster is a fine grained, massive variety, white or shaded in colour. Silky and fibrous variety of gypsum is called satin spar. Anhydrite (CaSO_4) is a calcium sulphate mineral found associated with gypsum commonly as a massive or fibrous mineral.

Gypsum that occurs in nature is called mineral gypsum. In addition to mineral gypsum, seawater and some chemical plants are sources of by-product marine gypsum and by-product chemical gypsum, respectively. The later is obtained as by-product phospho-gypsum or fluoro-gypsum or boro-gypsum, depending upon the source. Phosphoric acid plants are important sources of by-product phospho-gypsum.

Marine gypsum is recovered from salt pans during production of common salt in coastal region, particularly in Gujarat and Tamil Nadu. The recovery of by-product gypsum and marine gypsum together is substantial and is comparable with the production of mineral gypsum.

Synthetic gypsum is recovered via flue gas desulphurisation at some coal fired electric power plants in western countries.

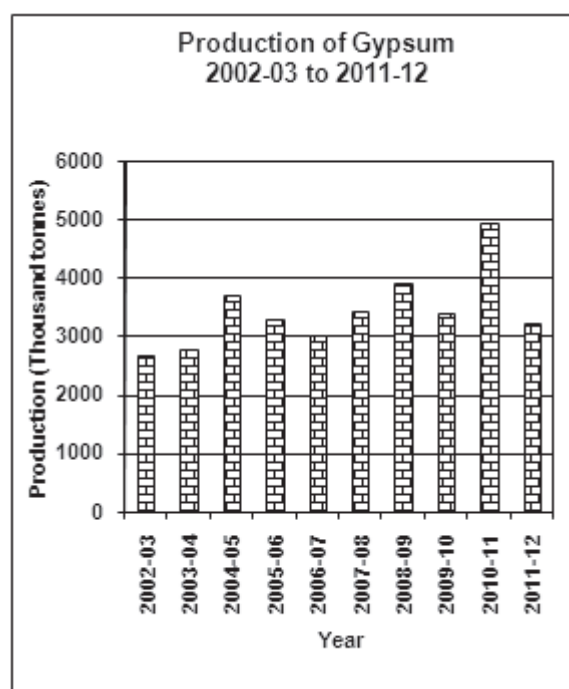
RESOURCES

As per UNFC system, the total resources of mineral gypsum in India as on 1.4.2010 were estimated at 1,286 million tonnes of which 39 million tonnes have been placed under 'reserves' and 1,247 million tonnes under 'remaining resources' category.

Of the total resources, fertilizer/pottery grade accounts for about 82% and cement/paint grade 12%. The unclassified and not-known grades together account for 5% resources. The remaining one percent of resources is shared by surgical plaster and soil reclamation grades. By States, Rajasthan alone accounts for 82% resources and Jammu & Kashmir 14% resources. The remaining 4% resources are in Tamil Nadu, Gujarat, Himachal Pradesh, Karnataka, Uttarakhand, Andhra Pradesh and Madhya Pradesh (Table-1).

EXPLORATION & DEVELOPMENT

During 2011-12, in western part of Haryana, GSI carried out reconnaissance stage investigation to assess the potential of gypsum in inter-dunal areas covered by a sediment. DMG, Rajasthan also carried out exploration in Khajuwala and Pugal in Bikaner district and in areas around Tadana in Jaisalmer district. The detail of exploration activities carried out by various agencies for gypsum are given in Table-2.



**Table – 1 : Reserves/Resources of Gypsum as on 1.4.2010
(By Grades/States)**

(In '000 tonnes)

Grade/State	Reserves			Remaining resources					Total resources (A+B)		
	Proved STD111	Probable STD121 STD122	Total (A)	Feasibility STD211	Pre-feasibility STD221 STD222	Measured STD331	Indicated STD332	Inferred STD333		Reconnaissance STD334	Total (B)
All India : Total	22494	239 16363	39096	8502	73651 17659	8455	710853	428272	10	1247402	1286498
By Grades											
Surgical plaster	776	- -	776	-	1039 82	-	-	3773	-	4894	5670
Fertilizer/Pottery	8097	81 276	8454	2196	9185 270	7680	703244	320454	-	1043029	1051483
Cement/Paint	9955	158 16087	26200	6120	63035 14677	532	2876	39366	10	126616	152816
Soil reclamation	-	- -	-	185	392 2573	100	206	7939	-	11395	11395
Unclassified	-	- -	-	-	- 56	78	2943	33548	-	36625	36625
Not-known	3666	- -	3666	-	- -	66	1585	23191	-	24842	28508
By States											
Andhra Pradesh	-	- -	-	-	- -	-	-	404	-	404	404
Gujarat	9	5 24	38	-	- -	-	-	15138	-	15138	15176
Himachal Pradesh	-	- -	-	-	- 1365	-	-	3081	-	4446	4446
Jammu & Kashmir	1664	153 442	2259	4784	9785 6570	7680	-	146694	-	175513	177772
Karnataka	-	- -	-	-	- -	-	-	3784	-	3784	3784
Madhya Pradesh	-	- -	-	-	- -	-	-	69	-	69	69
Rajasthan	20821	81 15834	36736	3405	63397 3105	750	710604	237550	-	1018811	1055547
Tamil Nadu	-	- 64	64	313	469 6584	25	249	19540	10	27190	27254
Uttarakhand	-	- -	-	-	- 35	-	-	2012	-	2047	2047

Figures rounded off

GYPSUM

Table – 2 : Details of Exploration Activities for Gypsum, 2011-12

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
GSI							
Haryana							
Hissar and Bhiwani	Western part of Haryana	-	-	-	-	17	Reconnaissance stage investigation was taken up during FS 2010-12 to assess the potential of gypsum in interdunal areas covered by alluvial/aeolian aeolian sediments. The area mapped shows the presence of both longitudinal and transverse dunes. Gypsum occurs in the area as pan and pocket type deposits. No charophytes were found during mapping. Gypsum values range from 67-85% in 8 samples, 41-58% in 5 samples and 25-34% in 4 samples out of 20 bedrock samples analyzed so far. Analyses of 15 nos. of pit samples indicate percentage of Gypsum ranging from 0.09-82.20%. Five shallow bore holes (up to 30m) have been drilled near Saharwa, Dar-yapur, east of Garanpura and west of Saharwa village. All the bore holes intersected poor to moderate grade gypsum bands laminae, associated with dirty white and brown clay, silty clay and sand. Chemical analysis of 15 nos. of pit samples and 13 nos. of core samples of SBH-1 indicates percentage of Gypsum ranging from 0.09-82.20% & from 14.08-80.84% respectively. The investigation is completed.
DMG							
Rajasthan							
Bikaner	Tah. Khajuwala & Pugal	RMS RGM DGM	500 30 10	-	-	27 (Chemical Analysis)	New gypsum occurrences were located in about 10 sq km area around 20 SMD to 24 SMD Tuvaranwala and Nasuma village. About 15 million tonne reserve of Gypsum were proved in the area.
Rajasthan							
Jaisalmer	N/v Tadana Tah. Jaisalmer	RMS RGM DGM	150 15 01	-	-	15 (Chemical Analysis)	Potential bed of Gypsum exposed in about 0.5 sq km. Thickness of Gypsum bed varies from 0.5 to 1.8 m below to top soil of 0.1 to 0.5 m. The Gypsum is earth to off white - greyish in colour, soft to moderately hard porous and also mixed with sand impurities.

GYPSUM

PRODUCTION, STOCKS AND PRICES

Gypsum

The production of gypsum in 2011-12 at about 3.19 million tonnes decreased by 35% as compared to that in the previous year.

There were 35 reporting mines during the year as against 30 in the preceding year. Two principal producers together accounted for about 99% of the total production of gypsum in 2011-12. Five mines, each producing above 2 lakh tonnes annually contributed about 70% of total production, 2 mines, each producing between 1 to 2 lakh tonnes contributed about 9% of the total production, 3 mines, each producing 50 thousand tonnes to 1 lakh tonnes contributed about 6% of total production, and 15 mines, each producing between 10 thousand to 50 thousand tonnes accounted for 15% of total production. Nominal production of gypsum was reported from 10 other mines, each producing below 10,000 tonnes annually. Almost the entire production of gypsum was contributed by public sector and a nominal quantity of production was reported by private sector.

Rajasthan state continued to be the leading producer, contributing 99% of total output. The remaining 1% was contributed by Gujarat and Jammu & Kashmir (Tables - 3 to 6).

The mine-head stocks of gypsum at the end of 2011-12 were 155129 tonnes as against 45,868 tonnes at the beginning of the year (Table - 7).

The average daily labour employed in gypsum mines during 2011-12 was 339 as against 323 in the previous year.

Domestic prices of gypsum are furnished in the General Review on 'Prices'.

Selenite

The production of selenite was 12,852 tonnes in the year 2011-12 as against 6,736 tonnes during the previous year. The entire production of selenite was reported by Rajasthan State Mines & Minerals Ltd. (RSMML), operating 3 mines in Barmer & Bikaner districts of Rajasthan (Tables - 8 to 10).

The average daily labour employed in selenite mines during 2011-12 was 39 as against 33 in the previous year.

Domestic prices of selenite are furnished in the General Review on 'Prices'.

Table – 3 : Principal Producers of Gypsum, 2011-12

Name and address of producer	Location of mine	
	State	District
Rajasthan State Mines & Minerals Ltd, C 89-90, Janpath Lal Kothi Scheme, Jaipur- 302 015, Rajasthan.	Rajasthan	Bikaner Sri Ganganagar Hanumangarh Jaisalmer Jalore Nagaur
FCI Aravali Gypsum & Minerals India Ltd, (formerly known as Fertilizer Corp. of India Ltd) Mangu Singh Rajvi Marg, Paota 'B' Road, Jodhpur-342 010, Rajasthan.	Rajasthan	Bikaner Sri Ganganagar Jaisalmer

GYPSUM

Table – 4 : Production of Gypsum, 2009-10 to 2011-12(P)
(By States)

(Qty in tonnes; value in ₹'000)

States	2009-10		2010-11		2011-12 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	3370322	1004631	4918170	1475454	3189229	1315174
Gujarat	112	15	37	14	20	6
Jammu & Kashmir	33197	9959	38143	11443	29505	8852
Rajasthan	3337013	994657	4879990	1463997	3159704	1306316

Table – 5 : Production of Gypsum, 2010-11 & 2011-12(P)
(By Sectors/States/Districts)

(Qty in tonnes; value in ₹'000)

State/District	2010-11			2011-12 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	30	4918170	1475454	35	3189229	1315174
Public sector	28	4918133	1475440	33	3185164	1313347
Private sector	2	37	14	2	4065	1827
Gujarat	2	37	14	1	20	6
Kachchh	2	37	14	1	20	6
Jammu & Kashmir	2	38143	11443	2	29505	8852
Doda	1	3207	962	1	6946	2084
Ramban	1	34936	10481	1	22559	6768
Rajasthan	26	4879990	1463997	32	3159704	1306316
Barmer	-	-	-	2*	-	-
Bikaner	8	3337834	1001350	9	1823981	743798
Sri Ganganagar	10	396975	119093	12	355262	148126
Hanumangarh	3	78010	23403	4	28028	11271
Jaisalmer	3	696631	208989	3	569908	230177
Jalore	1	21502	6451	1	33232	13293
Nagaur	1	349038	104711	1	349293	159651

*: Mines reported only labour.

Table – 6 : Production of Gypsum, 2010-11& 2011-12 (P)
(By Frequency Groups)

(Qty. in tonnes)

Production group	No. of mines		Production for the group		Percentage in total production		Cumulative percentage	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12(P)	2010-11	2011-12
All Groups	30	35	4918170	3189229	100.00	100.00	-	-
Up to 10000	5	10	14711	28847	0.30	0.90	0.30	0.90
10001-50000	13	15	434425	485756	8.83	15.23	9.13	16.13
50001-100000	2	3	140531	182886	2.86	5.73	11.99	21.86
100001-200000	3	2	401496	271870	8.16	8.52	20.15	30.38
Above 200000	7	5	3927007	2219870	79.85	69.62	100.00	100.00

GYPSUM

**Table - 7: Mine-head Stocks of Gypsum,
2011-12
(By States)**

State	(In tonnes)	
	At the beginning of the year	At the end of the year
India	45868	155129
Gujarat	416	436
Jammu & Kashmir	3	3
Rajasthan	45449	154690

**Table – 8 : Principal Producers of Selenite
2011-12**

Name & Address of Producer	Location of Mines	
	State	District
Rajasthan State Mines & Minerals Ltd, C 89-90, Janpath Lal Kothi Scheme, Jaipur –302 015, Rajasthan	Rajasthan	Barmer & Bikaner

**Table – 9 : Production of Selenite, 2009-10 to 2011-12
(By State)**

State	(Qty in tonnes; value in ₹'000)					
	2009-10		2010-11		2011-12 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	14598	12408	6736	5726	12852	14547
Rajasthan	14598	12408	6736	5726	12852	14547

**Table – 10 : Production of Selenite, 2010-11 and 2011-12
(By Sector/State/Districts)**

State/District	(Qty in tonnes; value in ₹'000)					
	2010-11			2011-12 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	3	6736	5726	3	12852	14547
Public sector	3	6736	5726	3	12852	14547
Rajasthan	3	6736	5726	3	12852	14547
Barmer	2	2170	1845	2	3475	3924
Bikaner	1	4566	3881	1	9377	10623

MINING AND MARKETING

Gypsum is mined out by opencast manual mining except in a few semi-mechanised mines in Rajasthan. In semi mechanised mines, Gypsum is excavated by backhoe excavator and directly loaded into trucks/dumpers. The trucks and dumpers loaded with gypsum are despatched directly to user industry or to railway siding for further loading into railway wagons for user industry. The deposits are found at shallow depths and scattered over large areas. Production is classified into four grades based on the calcium sulphate (CaSO₄ 2H₂O) content (i) above 90%, (ii) 85-90% (iii) 80-85% and (iv) less than 80%.

High grade gypsum is mined in Bikaner and Jaisalmer districts of Rajasthan. Some gypsum mines in Bikaner district also produce crystalline variety i.e. selenite. Gypsum from Rajasthan is despatched to cement plants in India spread over Rajasthan, Gujarat, Madhya Pradesh, West Bengal, Uttar Pradesh, Bihar, Jharkhand, Chhattisgarh, Himachal Pradesh, etc. Besides, a substantial quantity, containing about 60-70% CaSO₄ 2H₂O is supplied to Punjab, Uttar Pradesh, Haryana, Delhi, etc. for reclaiming alkaline soil. A sizeable quantity of gypsum from mines in Barmer, Bikaner, Jaisalmer, Hanumangarh, Sri Ganganagar and Nagaur districts of Rajasthan is also supplied to the Plaster of Paris units in Rajasthan, Uttar Pradesh, Haryana, Maharashtra, West Bengal, Delhi, etc.

GYPSUM

M/s Saint Gobain India Ltd (formerly known as India Gypsum Ltd) and Lafarge Boral Gypsum India Pvt Ltd are among the market leaders in Plaster of Paris industries and specialise in dry construction techniques. Its products are marketed under various brand names like Gypboard, Gypsteel, Gyptone, Gyproc CalSica, Fibre Cement Board, Gyproc, Casaprano, Gyprex, Celotex, Certainteed, LaGypTM, etc.

USES AND SPECIFICATIONS

Cement, fertilizer (ammonium sulphate) and Plaster of Paris are the three important industries in which gypsum is utilised. Gypsum of less purity in crushed form is utilised in portland cement manufacture for controlling the setting time of portland cement (i.e. as a retarder to prevent quick set). It is added to the clinker just before final grinding to finished cement. Proportion of gypsum in cement industry is 4-5% of the cement produced. Both, mineral and by-product gypsum are used in cement manufacture. Calcined gypsum finds use in manufacturing plaster of Paris. It is also used in manufacturing partition blocks, sheets and tiles, insulation boards for stucco and lattice works. Gypsum board is primarily used as a finish for walls and ceilings. It is also used as a binder in fast dry tennis court clay. Low grade gypsum is calcined and used as gypsum plaster after preparation of mortar. It is used for internal plastering and masonry work. Requirement of low-grade gypsum for use in building industry as per IS:12654-1989 (Reaffirmed 2010) is: $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ not less than 60%. In pottery, calcined gypsum is used for preparation of moulds in the production of sanitarywares. The used and discarded moulds are in turn again used as source of gypsum in cement and other industries. Low-grade gypsum is used in conditioning of alkaline soil and as a manure in agriculture mainly for correcting black alkali soils. BIS has prescribed IS:6046-1982 (First Revision; reaffirmed 2008) for gypsum for agricultural use.

Selenite, a crystalline variety is used to a limited extent for gypsum plate for petrological microscopes, known as Sensitive Tint. It is also used in the ceramic industry for making moulds,

to manufacture surgical grade Plaster of Paris and also for producing white cement. Plaster of Paris industry requires high purity gypsum. Different grades of plaster of Paris are manufactured depending upon the period for setting. For surgical plaster, a minimum 96% $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ grade gypsum is required.

High-purity gypsum may be utilised for manufacturing of ammonium sulphate fertilizer. Ground pure white gypsum is also used as a filler in paper, paints and textile goods. Ground low grade gypsum is used in mine dusting, manufacture of black board chalks and as a filler in insecticides. Besides, gypsum is also used in other industries like pharmaceutical, textile and asbestos products.

Alabaster, a dense, massive, granular and translucent variety, is employed as ornamental stone in statuary and interior decoration.

BIS specification for by-product gypsum (IS:10170-1982, reaffirmed 2008) lays down a minimum 70% content of $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ and maximum limit of 0.75% Na, 1.0% F and 15% free moisture on dry basis. The material should pass through 2 mm sieve, but 50% of material should also pass through 0.25 mm (60 mesh) sieve. Specifications of mineral gypsum for different industries are given in Table-11. The specifications of by-product gypsum for use in plaster, blocks and boards, as per IS:12679-1989 (reaffirmed 2010), is given in Table-12. Besides, BIS has prescribed IS:1290-1973 (Second Revision; reaffirmed 2011) for mineral gypsum.

BY-PRODUCT GYPSUM

Phospho-gypsum

Phospho-gypsum is produced as a by-product during the manufacture of phosphoric acid by wet process. Generally, a tonne of phosphoric acid production generates about 4 to 6 tonnes of phospho-gypsum. The principal producer of phospho-gypsum are given in Table-13.

The purity of phospho-gypsum ranges from 77 to 98% $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. It contains about 0.2 to 0.7% total P_2O_5 . Phospho-gypsum is mostly used in cement and fertilizer industries.

GYPSUM

Table – 11 : Specifications of Mineral Gypsum in Different Industries

Constituent	Surgical plaster	Ammonium sulphate fertilizer	Pottery	Cement	Reclamation of soil	Extender in paints
Free water	1.0% (max)	–	1.0% (max)	–	–	0.5% (max) when heated for 2 hr. at 45°C
CO ₂	1.0% (max)	–	3.0% (max)	–	–	–
SiO ₂ & other insoluble matter	0.7% (max)	6.0% (max)	6.0% (max)	–	–	–
Iron & aluminium oxide	0.1% (max)	1.5% (max)	1.0% (max)	–	–	–
MgO	0.5% (max)	1.0% (max)	1.5% (max)	3.0 (max)	–	–
CaSO ₄ .2H ₂ O	96.0% (min)	85-90% (min)	85.0% (min)	70-75% (80-85% for export quality cement)	70% (min)	75% (min)
NaCl	0.01% (max)	0.003% (max)	0.1% (max)	0.5% (max)	–	–
Na ₂ O	–	–	–	–	0.75% (max) (Na)	–
Fineness	–	–	–	–	Residue on 2 mm sieve : Nil & on 0.25 mm sieve : 50% (max)	Residue on 240 mesh B.S. test sieve : 0.5%
Oil absorption	–	–	–	–	–	Within 5% of the approved sample
Colour	–	–	–	–	–	Close match to the approved sample
Lead & its compounds (calculated as metallic lead)	–	–	–	–	–	0.5% (max) when lead-free gypsum is required.
Physical form	–	–	–	–	–	In the form of dry powder.
Microscopic form	–	–	–	–	–	Material should match entirely with the characteristics of gypsum crystals.

GYPSUM

**Table – 12 : Requirement of By-product Gypsum for Use in Plaster, Blocks and Boards
(IS:12679 - 1989, Reaffirmed 2010)**

Sl. No.	Characteristic	Requirement		
		Phospho-gypsum	Fluoro-gypsum	Marine-gypsum
1.	P ₂ O ₅ , % by mass, max	0.40	–	–
2.	F, % by mass, max	0.40	1.00	–
3.	Na ₂ O, % by mass, max	0.10	–	–
4.	K ₂ O, % by mass, max	0.20	–	–
5.	Organic matter, % by mass, max	0.15	–	–
6.	CaSO ₄ .2H ₂ O, % by mass, max	85.00	90.00*	85.00
7.	Cl as NaCl, % by mass, max	0.10	–	0.10
8.	pH of 10% aqueous suspension of gypsum, min	5.00	5.00	6.00

*Note: * Fluoro-gypsum shall be in anhydrous form (as CaSO₄).*

Table – 13 : Principal Producers of Phospho-gypsum

State	Unit
Andhra Pradesh	Coromandel International Ltd, Visakhapatnam.
Gujarat	(i) Gujarat State Fertilizers and Chemicals Ltd, Fertilizernagar, Vadodara district. (ii) Hindalco Industries Ltd, P.O. - Dahej.
Kerala	(i) Fertilizers & Chemicals Travancore Ltd, Udyogmandal, Ernakulam district. (ii) Fertilizers & Chemicals Travancore Ltd, Ambalamedu, Ernakulam district.
Maharashtra	Rashtriya Chemicals & Fertilizers, Chembur, Mumbai.
Odisha	(i) Paradeep Phosphates Ltd. (ii) IFFCO, Paradeep, district Jagatsinghpur.
Tamil Nadu	(i) Southern Petrochemical Industries Corporation Ltd, Thoothukudi. (ii) Coromandel International Ltd, Ennore, Thiruvallur. (iii) Sterlite industries (India) Ltd, Thoothukudi.
West Bengal	Tata Chemicals Ltd, Haldia.

Fluorine and phosphate contents in by-product gypsum are considered deleterious. The phosphate content affects setting properties of cement and fluorine content causes ring formation in kiln. The limit generally specified for use in cement is 0.15% P₂O₅ maximum. Phospho-gypsum is radioactive due to the presence of naturally occurring uranium and radium in the phosphate ore. Phospho-gypsum contains about 1% P₂O₅, 1% F and 10 to 30 times more radon; none is desirable. These entities along with radon that were a scare in the 1980s resulted in a 1989 EPA (Environment Protection Agency, USA) ruling that phospho-gypsum is unsuitable for sale as common gypsum.

Fluoro-gypsum

Fluoro-gypsum is obtained as by-product during the manufacture of aluminium fluoride and hydrofluoric acid using fluorite. Important units producing aluminium fluoride were Navin Fluorine International Ltd, Bhestan, Surat district, Gujarat; Tanfac Industries Ltd Cuddalore, South Arcot district, Tamil Nadu; Maya Rasayan Ltd, Mumbai; Tanfac Industries Ltd, SPIC; Aegies Chemical Ltd Dombivali, Thane, Maharashtra, etc. which may recover fluoro-gypsum in their chemical plants.

GYPSUM

Boro-gypsum

By-product boro-gypsum is obtained at a plant which refines calcium borates (colemanite and ulexite) to produce borax and boric acid. Borax Morarjee Ltd, Ambarnath, Thane district, Maharashtra and Southern Borax Ltd, Chennai engaged in refining of borates were reporting production of by-product boro-gypsum, in the past. However, detailed information on production of boro-gypsum from these two plants is not available. National Peroxide Ltd, Kalyan, Maharashtra is producing sodium perborate; information on production of boro-gypsum, if any at this plant is not available. As a thumb rule, for one tonne production of boric acid, about 2 tonnes of boro-gypsum is produced.

Marine Gypsum

Marine gypsum is obtained as a by-product during the production of common salt by solar evaporation. The total production of marine gypsum as per the Salt Commissioner, Jaipur, was 142,289 tonnes in 2010-11 and 166,665 tonnes in 2011-12, reported from Gujarat and Tamil Nadu. Marine gypsum recovered from Gujarat, earlier, showed 89.72-92.62% $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, 0.48 to 2.08% NaCl, 0.57% MgCl_2 , 3.42% MgSO_4 and 3.48 to 7.65% insolubles. No recent test result are available.

CONSUMPTION

About 8.12 million tonnes gypsum in all forms was consumed in organised sector in 2011-12 as against 8.11 million tonnes in 2010-11. In addition, a substantial quantity of mineral gypsum as well as phospho-gypsum was used in agricultural sector for conditioning of alkaline soil. The respective share of natural gypsum, by-product phospho fluoro gypsum and marine gypsum in total consumption during 2011-12 was about 54%, 41%, and 5%. Consumption of Gypsum in plaster of paris moulds was reported less than 1%. Almost entire quantity of natural gypsum in 2011-12 was consumed in the manufacture of cement (99%). The remaining nominal consumption was in plaster of paris, asbestos products, ceramic, fertilizer, refractories, textile, pharmaceutical, paint and chemical industries. The entire quantity of marine gypsum and gypsum moulds was consumed in cement and ceramic industries, respectively. By-product gypsum was also almost entirely consumed for manufacture of cement and meagre

consumption was in ceramic and fertilizer industries in 2011-12 (Table - 14).

INDUSTRY

Saint Gobain India Ltd (formerly known as India Gypsum Ltd) has been a pioneer in introducing light weight interior construction practices (Ceiling, drywall partition and gypsum plaster) and have plants located at Jind (Haryana), Wada (near Mumbai), Chennai and Bengaluru, producing gypsum plaster boards and accessories. Lafarge Boral Gypsum India Pvt Ltd (LBGI) is also among the market leader in designing, manufacturing and supplying gypsum board internal walls and ceiling solutions. They use mineral gypsum supplied from different mines of Rajasthan State Mines & Minerals Ltd (RSMML) and M/s. FCI Aravali Gypsum & Minerals India Ltd (FAGMIL), located mainly in Rajasthan.

In the year 2008-09, Rashtriya Chemicals and Fertilisers Ltd (RCF) formed a Joint Venture Company with Fertilizers and Chemicals Travancore Limited (FACT) by incorporating FACT-RCF Building Products Ltd to set up a Rapidwall project at Kochi. Both RCF and FACT have 50:50 equity holding in the Company. The plant was based on the use of gypsum available with FACT to produce load bearing wall panels, wall plaster and wall putty through Rapidwall technology. The JV has obtained BMTPC Certification for the wallpanels. The plant has been mechanically completed and commissioned on 1st June, 2012. The company has invested ₹ 1769 lakh (Previous year ₹ 1500 lakh) as its share in the Joint venture.

RCF has earmarked upon the manufacture of wall panels and other building materials from phospho-gypsum with Australian technology from M/s Rapidwall Building Systems Pvt Ltd, Australia (RBS). The project was set up at a cost of 81.10 crore, to utilise by-product phospho-gypsum produced in Trombay. It is a revolutionary and environment friendly, load bearing, prefabricated glass fiber reinforced walling system with broad construction applications. More than 500 wall panels were manufactured at Trombay and successfully tested at IIT, Chennai. The product has also received 'in principle' approval from Building Material Technology Promotion Council (BMTPC) under the Ministry of Housing and Urban Poverty Alleviation.

GYPSUM

**Table- 14: Reported Consumption of Gypsum, 2009-10 to 2011-12
(By Industries & Categorywise)**

(In tonnes)

Category	Industry	2009-10	2010-11(R)	2011-12(P)
All Industries :	Grand Total	6984200	8114000	8121500
Natural-Gypsum :	Total	3319800	4262800	4369700
	Asbestos products	700(4)	700(4)	700(4)
	Cement	3305700(57)	4243700(70)	4330500(72)
	Ceramic	400(1)	400(1)	400(1)
	Fertilizer	100(1)	100(1)	100(1)
	Paint	++(2)	++(2)	++(2)
	Pharmaceutical	800(1)	900(2)	900(2)
	Plaster of Paris	12100(3)	17000(4)	37100(4)
	Refractories	-	++(1)	++(1)
	Textile	++(1)	++(1)	++(1)
By-Product-Gypsum :	Total	3310400	3495300	3354800
	Cement	3309700(69)	3494600(73)	3354200(74)
	Ceramic	600(1)	600(1)	600(1)
	Fertilizer	100(1)	100(1)	++(1)
Marine-Gypsum :	Total	351300	353000	394100
	Cement	351300(13)	353000(15)	394100(16)
Gypsum-Moulds :	Total	2700	2900	2900
	Ceramic	2700(5)	2900(5)	2900(5)

Figures rounded off.

Figures in parenthesis denote the number of units in organised sector reporting consumption.*

*(*Includes actual reported consumption and/or estimates made wherever required).*

WORLD REVIEW

The world reserves of gypsum are large and adequate to meet the future demand. The total reported production of gypsum in 2011 was about 141.3 million tonnes as against 138.3 million tonnes in 2010. China was the largest producer accounting for 26%, followed by Iran, Iraq & Thailand (8% each), USA (7%), Mexico & Spain (5% each), Brazil (3%), and Australia, Canada, Egypt, France, India & Russia (2% each) (Table - 16).

**Table – 15 : World Reserve of Gypsum
(By Principal Countries)**

(In '000 tonnes)

Country	Reserve
World: Total (Rounded)	Large
Brazil	230000
Canada	450000
India	69000
Poland	55000
Other countries	NA

Source: Mineral Commodity Summaries, 2013

FOREIGN TRADE

Exports

Exports of gypsum and plaster at 51,732 tonnes in 2011-12 decreased by 49% from 100,918 tonnes in the preceding year. During the same period, export of alabaster was meagre at 1 tonne against 74 tonnes in the previous year. Gypsum & plaster were exported in bulk to neighbouring countries, viz, Nepal (84%) and Bangladesh (11%). Alabaster was exported to Nepal (Tables - 17 & 18).

Imports

Imports of gypsum & plaster at 27,76,177 tonnes in 2011-12 was substantially increased by 64% from 16,97,746 tonnes in 2010-11. Imports of alabaster marginally decreased to 1,138 tonnes in 2011-12 from 1,237 tonnes in 2010-11. Gypsum was imported mainly from Thailand (44%), Oman (21%) and Iran (16%). Alabaster was imported from Spain (96%) & Italy (4%). (Tables - 19 & 20).

GYPSUM

**Table – 16 : World Production of Gypsum
(By Principal Countries)**

(In '000 tonnes)

Country	2009	2010	2011
World: Total	138000	138300	141300
Algeria	1757	1610	1700 ^(e)
Argentina	1356	1346	1350
Australia	3436	3268 ^(e)	3029 ^(e)
Austria [@]	911	827	815
Brazil	3500	4000	4000 ^(e)
Canada [@]	3540	2717	2555
Chile	724	758	918
China ^(e)	37000	37000	37000
Egypt [@]	1035	1668 ^(e)	2138 ^(e)
France [@]	1887	2066	2452
Germany [@]	1898	1822	2021
India [#]	3370	4347 ^(e)	3323
Iran	13615	11914	12000 ^(e)
Iraq ^(e)	5026	8277	11350
Italy ^(e)	1600	1600	1600
Mexico	7543	6478	6464
Poland	1327	1399	1500
Pakistan	800	854	885
Russia ^(e)	2900	2900	2900
Spain	8181	6990 ^(e)	7100 ^(e)
Thailand [@]	9265	10708	11608
Turkey	4370	2851	991
UK ^(e)	1700	1700	1700
USA	9400	8840 ^(e)	9400
Other countries	11859	12360	12501

Source: World Mineral Production, 2007-2011.

@ Including Anhydrite, # Including Selenite.

Note: India's production of gypsum and selenite during 2009-10, 2010-11 and 2011-12 was 3,385 thousand tonnes, 4,925 thousand tonnes and 3,202 thousand tonnes, respectively.

**Table – 17: Exports of Gypsum & Plaster
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	100918	137642	51732	78485
Bangladesh	51126	69141	5633	8281
Kenya	311	3866	363	4076
Italy	-	-	30	1556
Malaysia	57	346	400	8240
Nepal	44958	39453	43645	36473
Netherlands	25	2172	208	2688
Saudi Arabia	521	2939	43	1399
South Africa	203	2888	243	1812
Sri Lanka	137	1201	140	1500
Tanzania Rep	79	1446	110	1514
Other countries	3501	14190	917	10946

GYPSUM

**Table – 18: Exports of Alabaster
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	74	329	01	49
USA	-	-	01	49
Other countries	74	329	-	-

**Table – 19: Imports of Gypsum & Plaster
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1697746	2212981	2776177	3979046
Thailand	935292	1199952	1217598	1682179
Oman	101920	140394	589703	846513
Iran	496925	577849	452759	594900
Pakistan	14908	24820	351450	528509
Indonesia	40963	53823	69205	84134
USA	1485	42885	1547	45427
China	1495	20982	6401	45364
UAE	58	314	31955	43109
Afghanistan	29654	39620	25721	36472
South Africa	-	-	14609	16661
Other countries	75046	112342	15229	55778

**Table – 20 : Imports of Alabaster
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1237	19920	1138	21525
Spain	398	6399	1089	20463
Italy	363	3631	49	1062
Other countries	476	9890	-	-

FUTURE OUTLOOK

India's domestic resources of gypsum are large enough to meet increased demand. The apparent domestic demand of gypsum was estimated at 5.66 million tonnes by 2011-12 and 8.71 million tonnes by 2016-17 at 9% growth rate as per the Report of the Working Group for 12th Plan, Planning Commission of India. The apparent consumption of Gypsum, Anhydrite, Marine gypsum and plaster during 2011-12 (P) was about 6.09 million tonnes.

India's main focus is the creation of more infrastructure with a view to infuse momentum in its economy and participation in its industrial development. These activities will keep the cement industry growing and accordingly, the consumption of gypsum will also increase, as per the Working Group reports. Further, as per the

report, steps would be necessary to find out suitable mining technology to exploit, deep-seated gypsum resources in Bhadvasi deposit, Nagaur district Rajasthan. State-of-the-art-technology needs to be adopted for the exploitation of deep-seated gypsum.

Production of gypsum wallboard in India is negligible. Its light weight and other special characteristics like attractive partition material could facilitate its utility in high rise building constructions. In view of the environmental problem arising from huge accumulation of phospho-gypsum at different fertilizer plants, possibilities of finding other plausible means for its utilisation has become a necessary. Low-grade gypsum being cheaper should be utilised more as a soil conditioner in the reclamation of alkaline soils.